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THE ISLANDS OF JUAN FERNANDEZ

By CARL SKOTTSBERG
University of Upsala, Sweden

A fine morning in the month of August, 1908, found my companion and myself climbing the steep and narrow ridges of Mas-afuera, the more remote of the Juan Fernandez Islands off the Chilean coast. We were eager to reach the high crest of that little island, for we knew that no scientist had ever set his foot on that particular spot. We were in great haste, for our time was short, as our vessel, a large Chilean government transport, must get away from the wretched anchorage as soon as possible. It was the accomplishment of an old ambition: for many years I had longed to see the famous island of Robinson Crusoe, Juan Fernandez, and the other members of its group.[1] And during my expedition to Patagonia and Tierra del Fuego, in 1907-09, I had quite unexpectedly obtained an opportunity to visit the islands. Unfortunately only twelve days were at my disposal, and the season was winter.

Discovery of Magellanic Flora

I was more or less familiar with the island flora, and the only investigation previously made in Mas-afuera did not hold out much hope of any great discoveries in my line. "Grass and thick mats and beds of ferns, right to the top"—thus ran the description of Dr. Federico Johow, the eminent Chilean botanist. But the tracks on his sketch map clearly showed that he never reached the high part of the island.[2] Above the forest we trod the grass of extensive meadows, but as we continued upwards the scenery changed. Outcrops of hard rock formed picturesque little chains; the ground was strewn with boulders; the peaty soil and the stunted vegetation resembled subantarctic heaths (Fig. 18). A small stream cut through the fern beds. I thrust aside the coarse ferns to quench my thirst. Then I suddenly stopped. For over the dewy moss trailed the tiny subantarctic bramble (*Rubus geoides*), and close by crawled the runners of the common subantarctic club moss (*Lycopodium magellanicum*). And there were the delicate rosettes of one of the dwarf mountain asters of the south (*Lagenophora*) and others which certainly had no right to exist in the latitude of Valparaiso (33°). I felt I had a reason to congratulate myself, for thus was made the discovery of the Magellanic flora in the Juan Fernandez Islands.

My companion and I made a hasty survey of the neighborhood. There was no time for serious work, the day was drawing to its close, and all material gathered was further restricted by the seasonal limitations: up here the winter rest is marked. But when I bade farewell to the summits of Mas-afuera I had already made up my mind to come back to camp at the little stream and force the island to yield its hidden treasures.[3] My

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[1] The name Juan Fernandez is applied both to the chief island, Mas-a-tierra, and to the group as a whole.

[2] Federico Johow: Estudios sobre la Flora de las Islas de Juan Fernandez, Santiago, 1896.

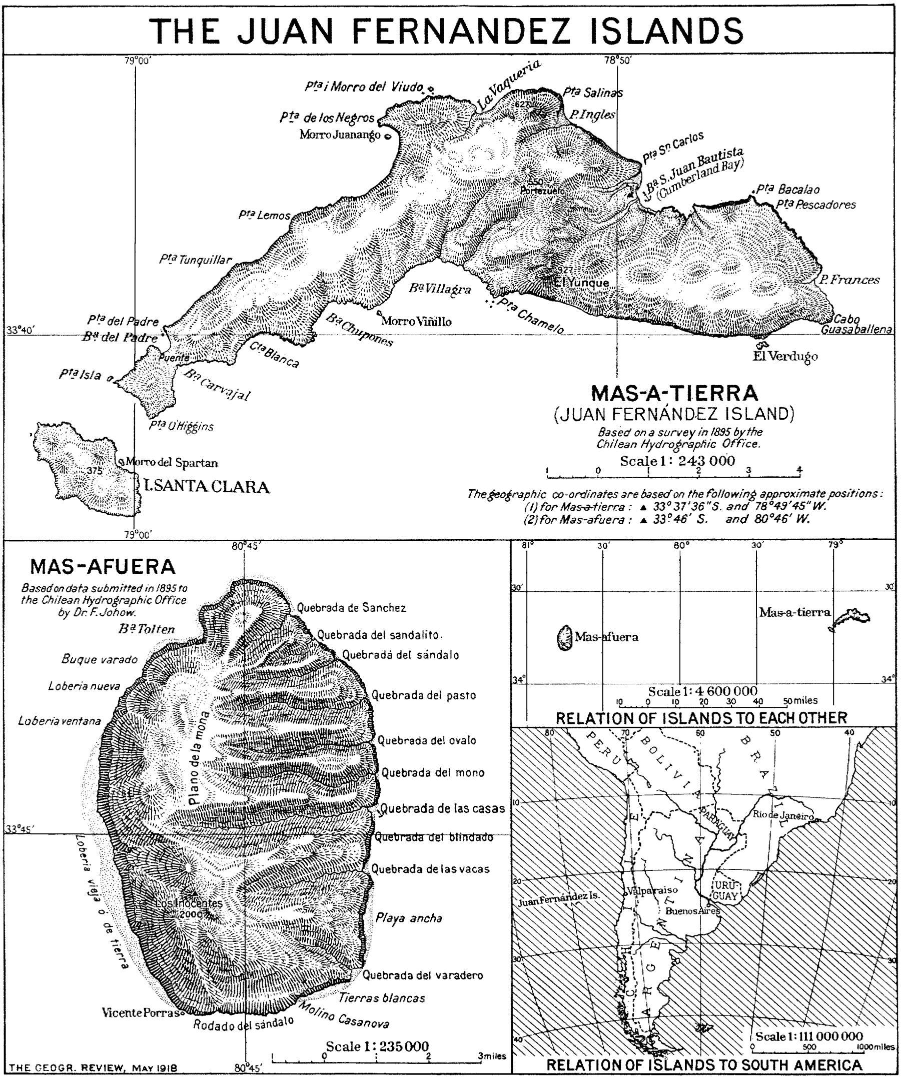

FIG. 1—Maps of the Juan Fernandez Islands: Mas-a-tierra, 1:243,000; Mas-afuera, 1:235,000. The authorities are cited in each case. Heights in meters.

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[3] Carl Skottsberg: The Wilds of Patagonia, London, 1911 (see Chapter 9). On the Magellanic flora see the author's article "Distribution of Vegetation in the Colder South Hemisphere," *Ymer*, Vol. 25, 1905, pp. 402-427, and the reports of the Swedish Antarctic Expedition, 1901-03, especially his: Pflanzenphysiognomie des Feuerlandes, *Wiss. Ergeb. der Schwedischen Südpolar-Expedition, 1901-1903* (Stockholm, various dates), Vol. 4, Part 9; Das Pflanzenleben der Falklandinseln, *ibid.*, Vol. 4, Part 10; The Vegetation in South Georgia, *ibid.*, Vol. 4, Part 12; Die Vegetationsverhältnisse des Graham Landes, *ibid.*, Vol. 4, Part 13.

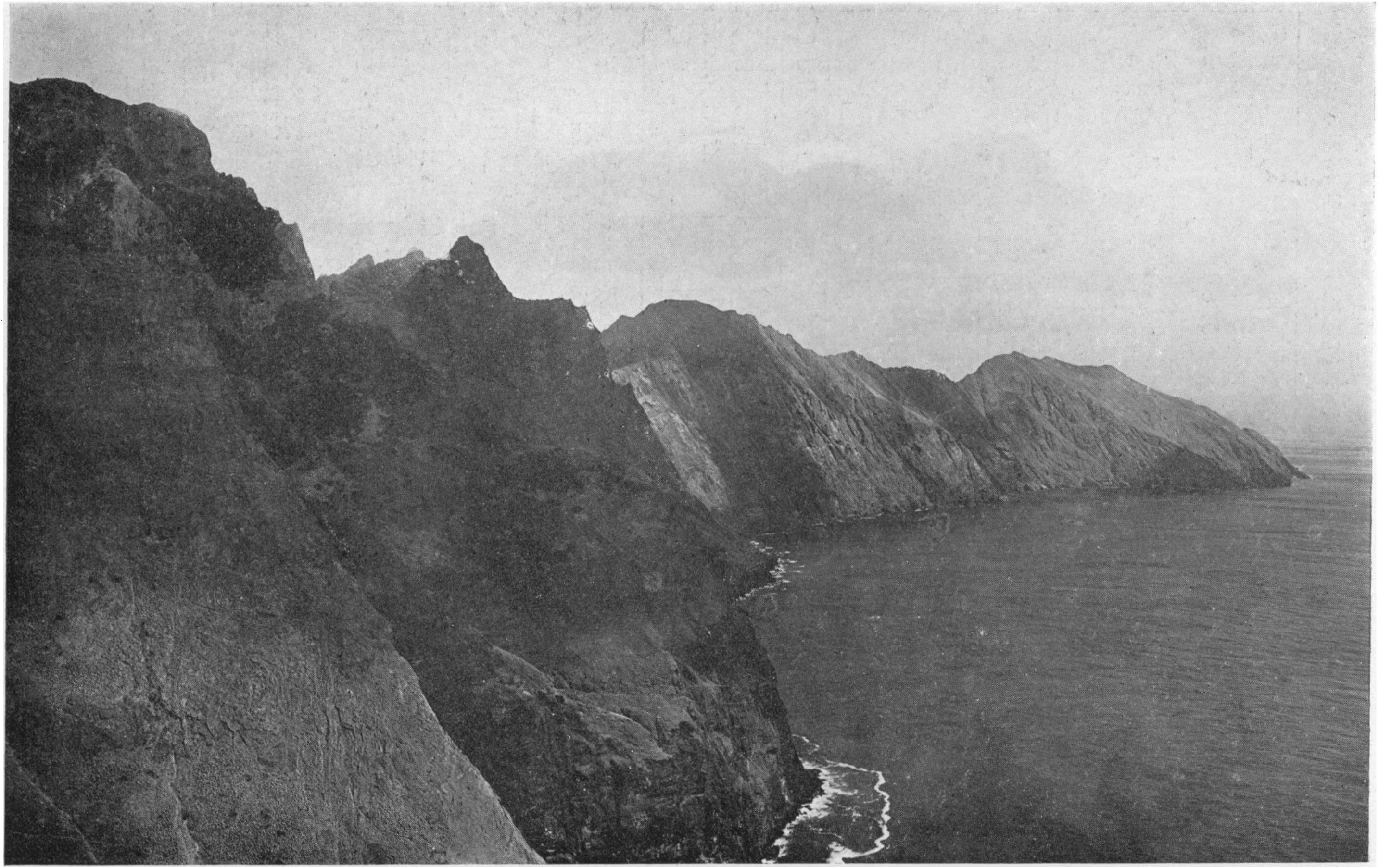

FIG. 2—The northern shore of the western part of Mas-a-tierra. Punta del Padre on the right. (Figs. 2-20 from photographs by the author.)

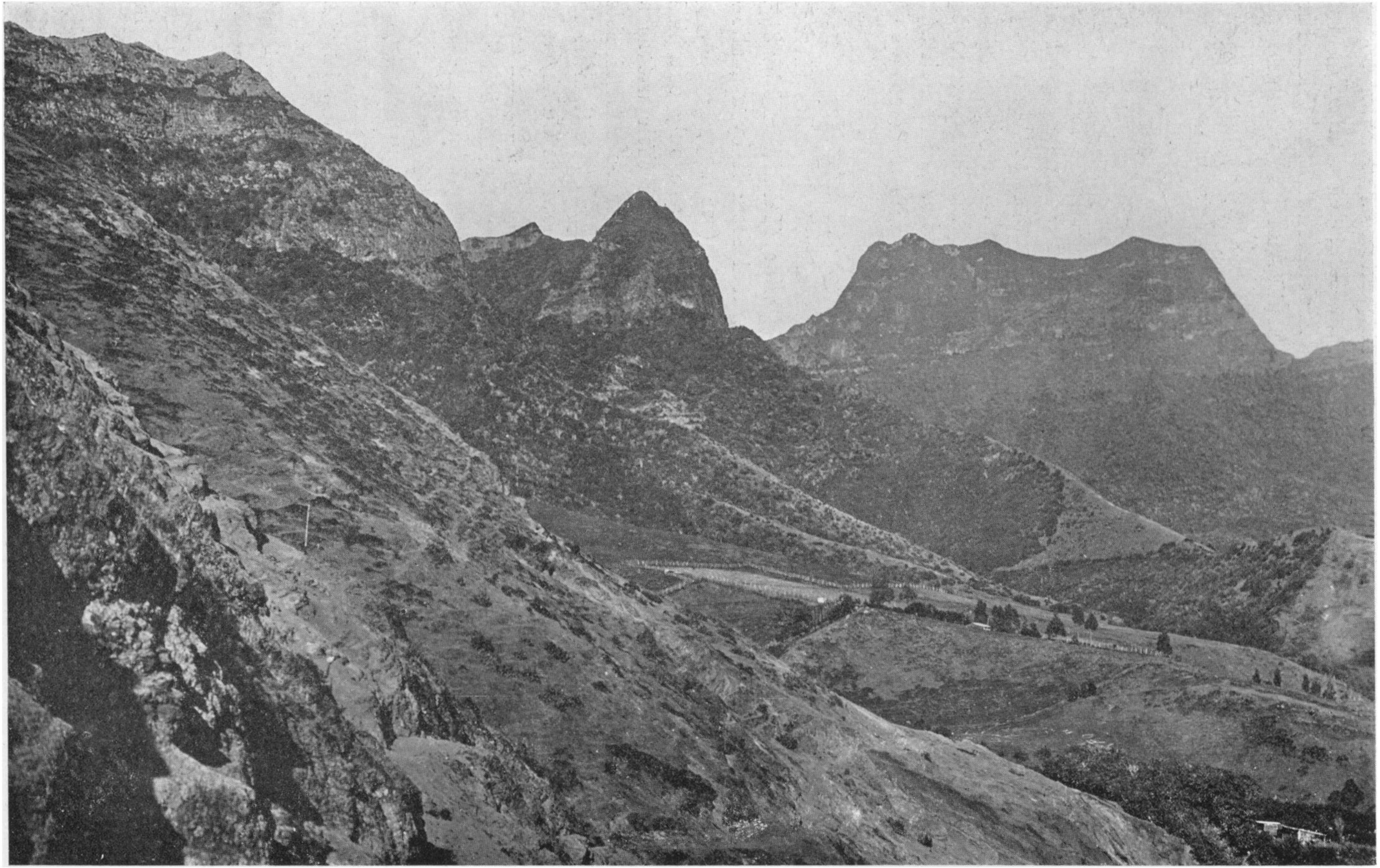

FIG. 3—The Anson valley, sloping toward Cumberland Bay, Mas-a-tierra. In the right background the massif of El Yunque. The slopes in the foreground are barren; those in the middle distance are covered with forest patches.

botanical results proved to have a remarkable interest. The large percentage of endemic and often highly peculiar forms characterizing the islands raises questions of a general nature. Problems of the physical history of the Pacific Ocean, its islands, and the South American mainland are involved, as well as that of the great plant and animal migrations that have taken place in this part of the world. The data accumulated in the short time available in 1908[4] needed amplification.

SWEDISH PACIFIC EXPEDITION

The new enterprise, known as the Swedish Pacific Expedition of 1916-17, was supported by the Royal Geographical Society of Stockholm and by a number of government institutions. Its aim was announced as "an attempt to carry out as complete a biological investigation of the outlying Chilean islands as possible, especially of Juan Fernandez." We left Sweden on October 4, 1916. Mrs. Inga Skottsberg was attached as botanical assistant, and I was further accompanied by Mr. K. Bäckström, who made zoölogical collections.

The Juan Fernandez group consists of two larger islands, Mas-a-tierra, 360 miles west by south of Valparaiso, and Mas-afuera, 90 miles farther west. Mas-a-tierra is about 12 miles long by 3⅔ wide, Mas-afuera 6 by 3½. At the southwest end of the former and separated from it by a shallow channel is the small and desolate islet of Santa Clara (see map, Fig. 1).

For many years after their discovery the islands were only occupied temporarily. In the mid-eighteenth century, to prevent their use as a rendezvous for pirates or as a provisioning station for other more formidable enemies, the Chilean governor created the first permanent settlement in Mas-a-tierra on the bay of San Juan Bautista, better known as Cumberland Bay (Fig. 8). The fortunes of the settlement fluctuated. On several occasions the island served as a penal station. Agricultural enterprises had little success. Today it enjoys a certain prosperity as the center of a flourishing fishing industry. The waters are rich in excellent fish, many species being peculiar to the place; yet this abundant variety is of minor importance. The colony, including some 300 souls, may be said to subsist on one single product, a large crustacean (*Palinurus frontalis*), known only on these islands and on the sterile islands of San Felix and San Ambrosio 500 miles farther north, where no settlement is practicable. This lobster is highly appreciated in Chile. Two canning factories have been established here, and three schooners carry the canned product as well as great quantities of live lobsters to the mainland. Nearly all the fishermen have their gardens, where fruit and vegetables are grown, and small herds of cattle graze in the well-watered valleys.

The expedition arrived in Mas-a-tierra on December 1, 1916, and remained until April 30, 1917. A laboratory was established in the colony, where we maintained our headquarters. February and the greater part of March were dedicated to the survey of Mas-afuera. Mr. Bäckström returned to Mas-a-tierra in July and spent a month there studying the winter fauna. All research work had to be done on foot. Three narrow and miserable cattle trails lead from Cumberland Bay to other parts, and it is possible to follow them on horseback, at least in the drier season; but some passages make the rider hold his breath and wish himself safe on the other side. The higher parts of the island can be reached only by following the narrow ridges that descend to the sea. Along these ridges, crowned by an outcrop of basaltic rock, are the old goat paths, many still visible in spite of the scarcity of these animals in later years. Goats apparently do not hesitate to use the most dangerous passages, but the traveler will sometimes hesitate to follow their trail. This explains why our survey yielded good results. The younger fishermen are daring climbers and stop at nothing in their pursuit of the goats or the *chonta* palm, which is much sought after for its wood. Occasionally they contributed to our knowledge of natural history, and one of them, Pedro Gutierrez, who was a great help to us from the first, later became a member of the expedition to Mas-afuera.

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[4] The scientific results were published in the *K. Svenska Vetenskapsakad. Handl., 1910-1916;* Part III (1914) deals with Juan Fernandez, Parts IV (1913) and V (1916) with the Andean and Magellanic floras.

The Island of Mas-a-tierra

All the islands are built of Tertiary volcanic rocks, nearly always beautifully layered. It is probable that they are early Tertiary: there is no trace of craters or of any recent volcanic action. The topography of Mas-a-tierra is very broken (Fig. 3). The eastern part is much the higher. It reaches its greatest elevation along the south side, culminating in the famous and truly inaccessible massif El Yunque (The Anvil), which falls abruptly down into the sea 3,100 feet. The upper part is of a hard, dark gray rock forming all the wild crests and peaks. The island has been greatly cut down by erosion, which has left a curved backbone and a long line of ribs separating deep valleys. Underlying the harder rocks are innumerable layers of tufa, red, brown, or yellow, that make a striking contrast to the vivid green of the forests. The rainfall is concentrated on the higher eastern and central portions of the island, where the air currents, rising suddenly from the south shore, condense their moisture. From the high backbone forest-clad valleys descend to the north coast and terminate in open bays. No level ground of any extent is seen; a tract like that shown in Figure 8 is a rare exception. Between the bays the shore is very steep, and the cliffs reach the height of a thousand feet in many places (Fig. 2).

The southwestern portion of the island, of which Santa Clara is a continuation, has a rather different appearance. The upper layers are upraised and form a high ridge along the northern margin, where the shores are precipitous. The valleys run in a southerly direction and do not reach the water; their streams are dry for several months. Accordingly, arborescent

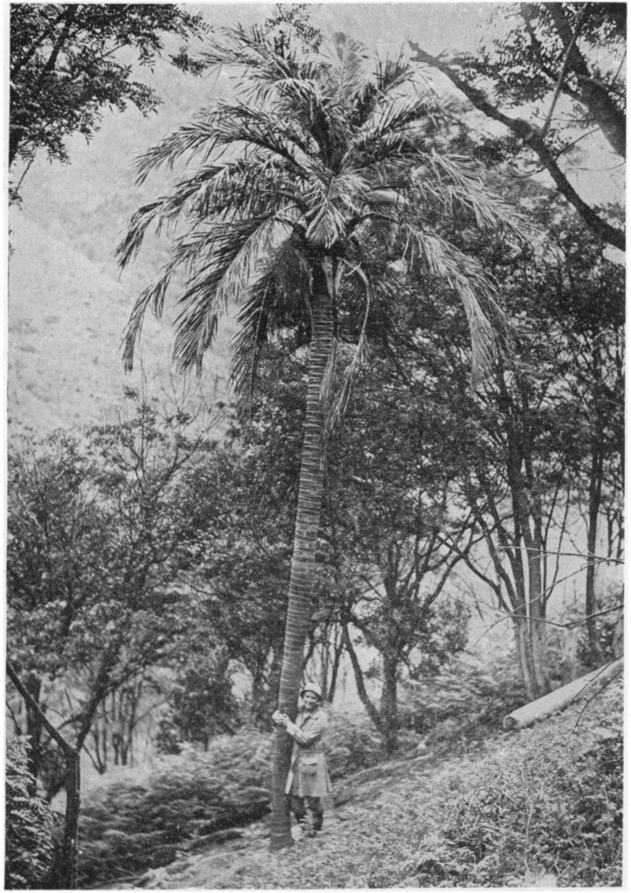

FIG. 4—The *chonta* palm (*Juania australis*).

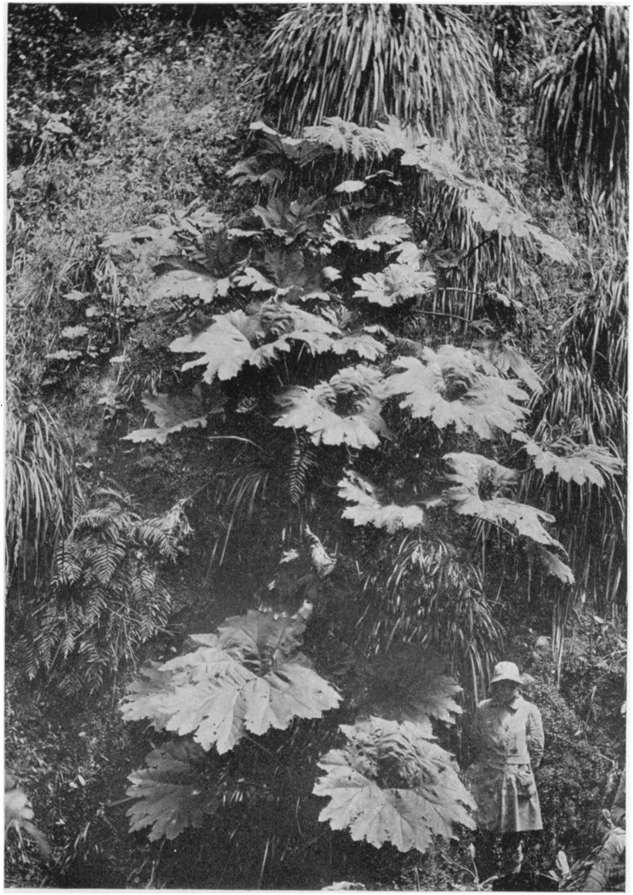

FIG. 5—A waterfall on Mas-a-tierra hidden by *Cladium*, a twig rush, and *Gunnera*, whose leaves attain man-size.

vegetation is entirely wanting, and for miles the ground is covered with grasses and herbs. Only the climate of the central part (Cumberland Bay) is well known. Here observations have been made many years. It shows a combination of comparatively high temperature and considerable rainfall not found on the coast of Chile.[5] The temperature is extremely agreeable; the summer is never very hot; and the winter is always mild, frost being unknown. Gales are frequent, and local winds rush down from the precipices and sweep through the valleys with tremendous force. A thick wet fog hangs round the summits even in the drier season, and the character of the vegetation further indicates that the climate of the higher portions is colder and wetter. The southwestern peninsula with Santa Clara has a different climate from the rest. It is and has always been destitute of trees.

A FOREST TRIP

In order to make the reader acquainted with the peculiar nature of Mas-a-tierra I shall now offer to be his guide on a trip through its forests and along its picturesque cliffs; but special note must be made of its different types of vegetation, for it is plant life more than anything else that puts its stamp on the scenery. Let us remember Darwin's saying: "A traveler should be a botanist."

In the valleys near the sea work is easy. The soil lies bare, the forest has been destroyed, erosion is very active. There one of the introduced Chilean weeds has won a considerable victory, thanks to its most efficient means of dispersal; it is a burnet, *Acaena argentea.* Cattle and sheep become covered with its fruits and carry them everywhere. From the lower hilly tracts we soon pass into low, pitch-dark thickets, formed by another stranger, the Chilean *Aristotelia maqui,* introduced some sixty years ago. It is able to germinate and grow in the deepest shadow, it sprouts from the base of its stem with amazing speed, and it has entered and conquered all the lower parts of the valleys. The berries are the staple food of the thrush, which sows it in thousands every year. To the native flora it has become a serious menace. Its vanguard has already reached the highest ridges. If nothing is done to check the formidable invader, much of the precious native flora is doomed.

At a height of 600 or 700 feet the forest still retains much of its original character, and many places remote from the colony are quite primeval. It is an evergreen rain-forest, much resembling, in general appearance, that of southern Chile. Several species are identical with those of Chile, others belong to Chilean genera, represented by endemic species. The commonest is a myrtle tree, *Myrceugenia fernandeziana,* with a smooth light-gray bark and a beautiful lustrous dark foliage, in early summer covered with innumerable white, fragrant flowers. The soil is strewn with fallen trunks, covered by a rich carpet of mosses. Ferns are plentiful; there are large and handsome forms, as well as minute, of the elegant *Hymenophylla.* Curiously enough, phanerogamic climbers are wanting; they are replaced by ferns with winding rhizomes reaching high up on the trunks of the trees and forming a most attractive and striking picture.

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[5] A summary of meteorological records of Chile is given and analyzed by R. C. Mossman: The Climate of Chile, *Journ. Scottish Meteorol. Soc.*, Vol. 15, 1911, pp. 313-346. For the first half-decade of this century the principal observations at Juan Fernandez show:—mean monthly temperature, February, 66.9° F.; August, 54° F.; absolute minimum, 38.8° F.; prevalent winds (blowing on 70 per cent of the observations), southeast to southwest; mean annual rainfall, 40.5 inches, of which 80 per cent falls from April to September. To find such a degree of rainfall on the Chilean coast one must pass to a considerably higher latitude.

Noteworthy Species

One of the most famous trees is a palm, *Juania australis,* a monotypical endemic genus, called *chonta* by the inhabitants (Fig. 4). It is now rare in the accessible valleys, for it has been sought and cut with great persistence on account of its handsome wood. True, cutting it is strictly prohibited, but the law is not rigidly enforced: not a vessel leaves the island without carrying away some of this wood. The *chonta* has its nearest relatives in tropical America but has no relation with the Chilean palm growing just opposite on the mainland. There are several other trees and shrubs altogether strange to the flora of Chile, or even to that of South America.

The forest flora of Juan Fernandez has suffered at least one great loss since man first settled there. The reader who knows the early history of the Spanish possessions will perhaps remember that the islands once were famous for their precious, perfumed sandalwood. So complete was the destruction of this remarkable tree that the first complete botanical description was written merely from twigs of the last specimen—and that as late as 1896! For almost a hundred years it had been sought in vain. I shall never forget my journey to pay homage to this tree in 1908. It was destroyed some years ago, and thus *Santalum fernandezianum* disappeared from the world. The genus is unknown in America, it is West Pacific and Indian, save for this single species blotted out by thoughtless man.

The Higher Vegetation

But let us hasten to the higher slopes and the mountain forest. We have entered the fog belt, where there is more moisture and less heat.[6] Even the ordinary traveler would note the change in vegetation. Many new species appear. Ferns become plentiful, and some are very striking. One is a proud tree-fern, *Dicksonia Berteroana* (Fig. 6), whose nearest relative is a species in Fiji. Another is the *Thyrsopteris elegans,* with leaves as long as 12 or 15 feet, having doubtful relations back in pre-Tertiary time but none in the present! Fine epiphytic ferns and large festoons of hanging moss

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[6] In order to gain some knowledge of the weather here we set up some instruments in the Portezuelo pass (Selkirk's "Lookout," where the memorial tablet was erected in 1868) and made observations every two days for some little time. But we had to climb 1,850 feet to read the instruments.

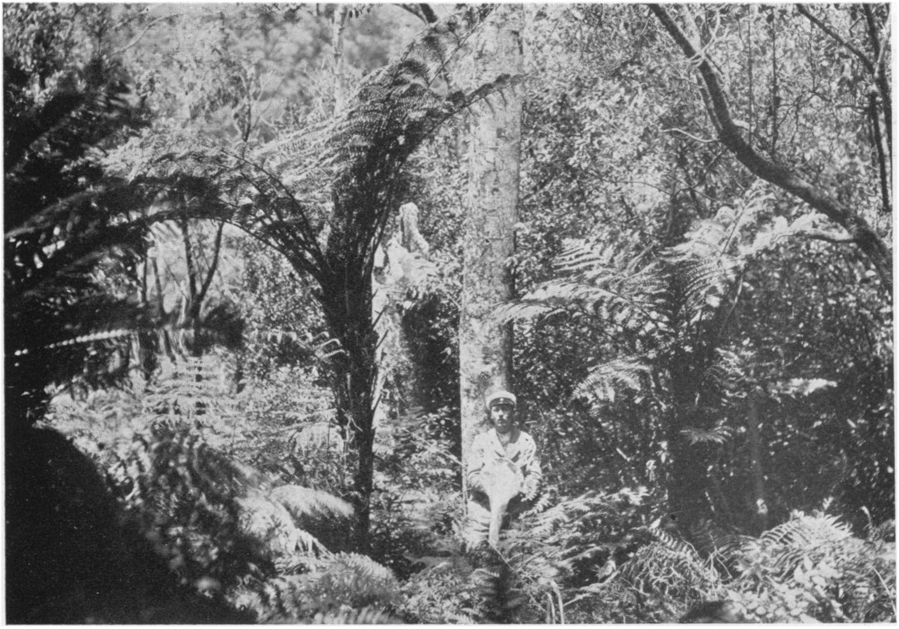

FIG. 6.

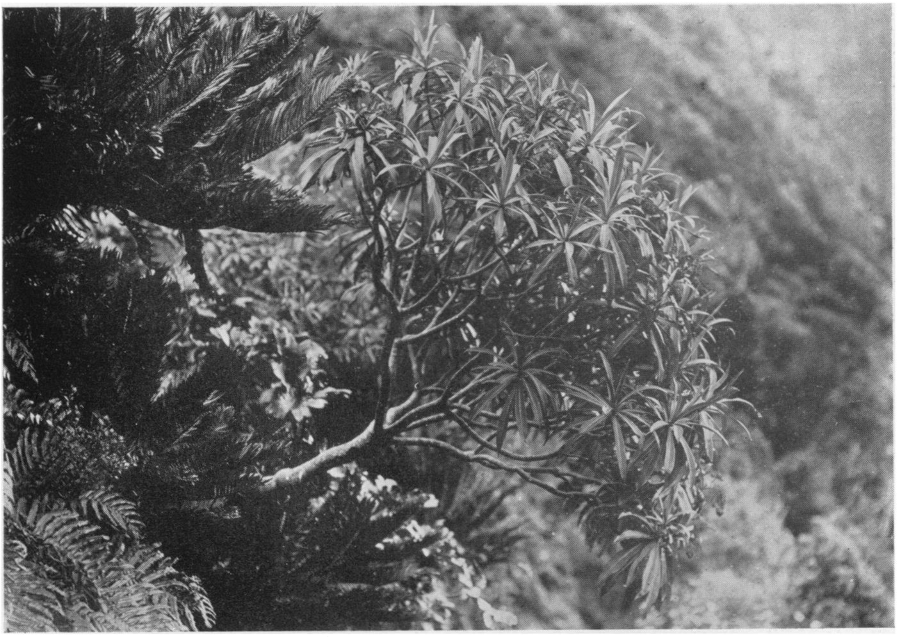

FIG. 7.

FIG. 6—Virgin forest on Mas-a-tierra, with tree-ferns (*Dicksonia Berteroana*).
FIG. 7—*Robinsonia thurifera*, one of the rarest plants of Mas-a-tierra.

cover the trees. This is the region where one of the rarest and most peculiar dwellers of Mas-a-tierra is found: *Lactoris fernandeziana,* forming the monotypical family Lactoridaceae. It stands somewhere near the magnolias and offers the only instance known of a natural order confined to an oceanic island.

At the bottom of every *quebrada* (Fig. 5) a small waterfall is generally encountered, where a stately twig rush (*Cladium scirpoideum*) hangs down over the dripping wet rocks. Round the brook an endemic *pangue* (*Gunnera peltata*) unfolds its gigantic leaves, borne on a stem many feet high. The special tree of the valley bottoms is a stout *Boehmeria,* of the nettle family, with distant tropical relations.

An excursion through the forest is easily described, but not so easily made. The sides of the valleys are very steep, especially when approaching the ridge. The soil is soaked with moisture and often gives way under foot. Only with the aid of the trunks and roots can ascent of these ridges be made, save in the few places where a path has been cleared, winding in sharp turns along a slope often as steep as 30° or 40°. Many places are impenetrable thickets of ferns, brushwood, and bamboo, so that it costs some labor to gain the stony ridge.

Figure 9 will give a good idea of one of the ridges. The limit of the forest is clearly visible. This is not a climatic limit. The soil is very thin or entirely wanting; vegetation is confined to crevices and narrow ledges and thus is naturally broken up. Moreover the ridge is dry in summer and very much exposed to the gales. Dense thickets of xerophytic shrubs, rigid ferns, and patches of hard grass are often encountered.

Miniature Trees

Along the upper limit of the closed forest, where light is strong, we meet with the host of plants which have helped to make these islands famous among botanists. They are peculiar miniature trees, belonging to endemic genera or at least species of various families, Compositae being most common. They have a simple or dichotomously branched stem, and the leaves are crowded at the end of the branches. Here are large woody *Eryngia,* a plantain tree, the rare *Selkirkia* (forget-me-not family), and several species of *Dendroseris, Robinsonia,* and other Compositae (Figure 7 is a good example). They constitute a perfect living museum of ancient types, either without relations or connected only with distant Pacific islands, thousands of miles away.

The view from the higher parts—and east of El Yunque a summit of 2,500 feet is reached without much difficulty—is truly magnificent. All around run the rocky ridges, sometimes as sharp as a knife edge and as steep as a wall, sometimes barren, sometimes heavily clad with ferns and mountain *pangues;* high, dominating peaks rise with a defiant air over richly carpeted slopes, brilliant with many flowers. Everywhere valleys

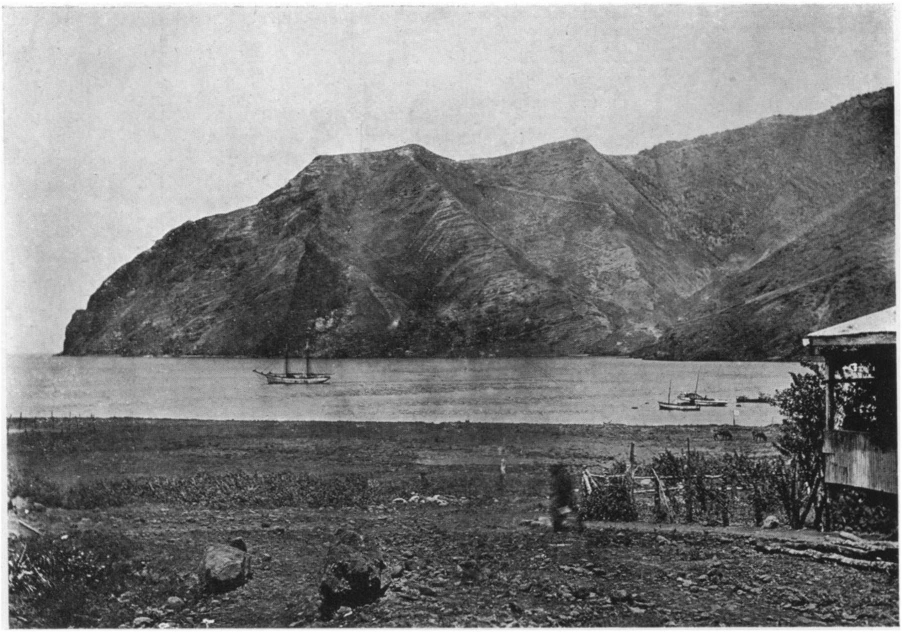

FIG. 8.

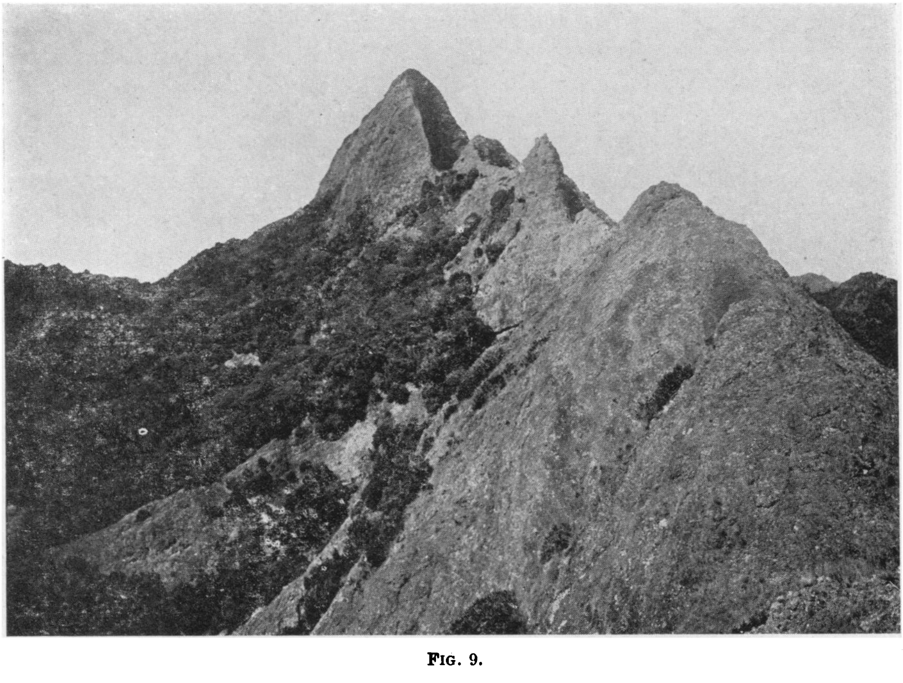

FIG. 9.

FIG. 8—Cumberland Bay, Mas-a-tierra.

FIG. 9—A typical rocky ridge on Mas-a-tierra. The limit of forest is not due to altitude but to absence of soil.

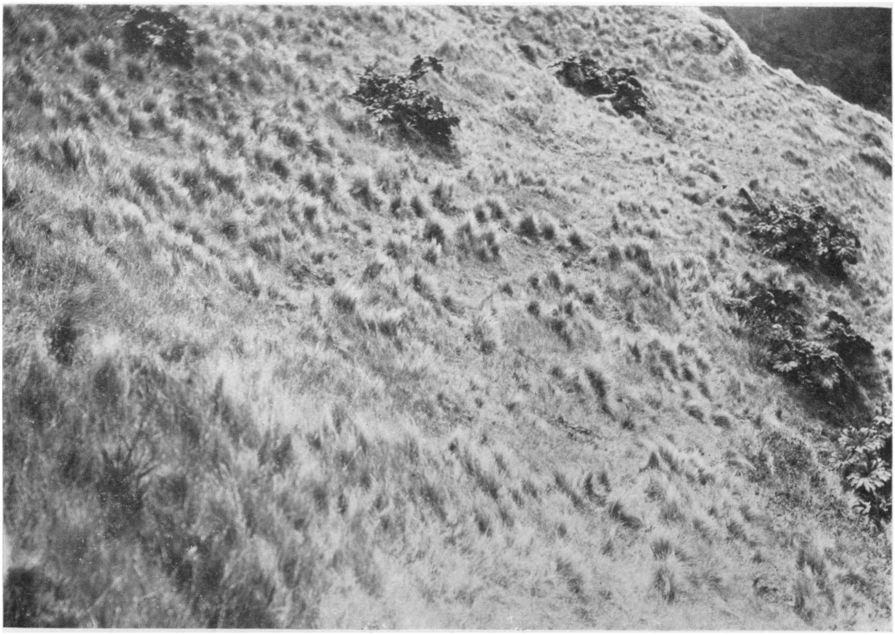

FIG. 10.

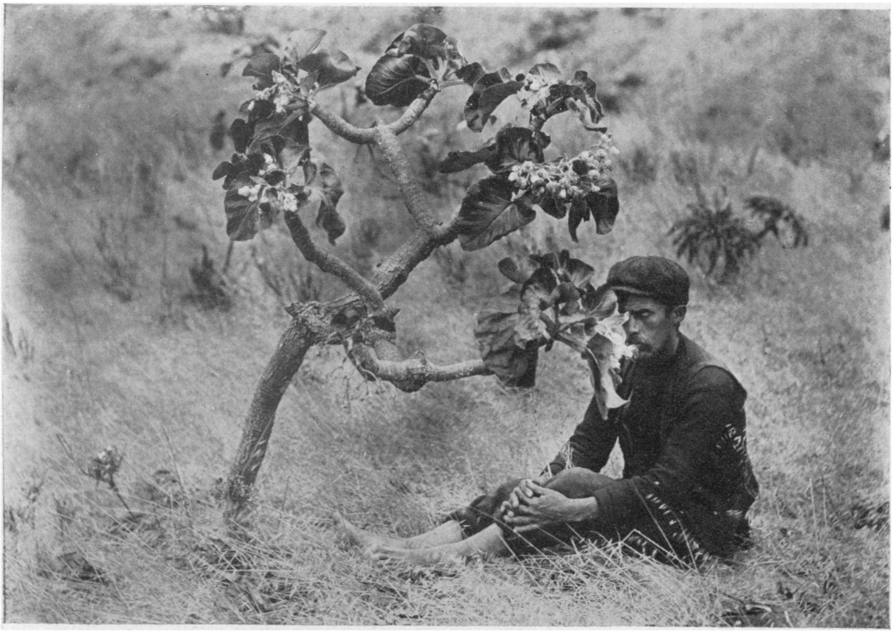

FIG. 11.

FIG. 10–Steppe vegetation in Mas-a-tierra. Small patches of *Gunnera*.

FIG. 11—*Dendroseris macrophylla* on Santa Clara. A miniature tree representing an ancient type. The leaves are glaucous, the flower-heads bright orange.

seem to descend, their bottoms hidden under luxuriant growth. *Chontas* raise their shapely heads above the green roof, waving in a fresh breeze that now and then uncovers a cluster of the scarlet berries. Down below follow the barren slopes, bright with the colors of the earth and suddenly falling away in precipitous cliffs, washed by the eternal surf. The wind brings the sound of the roaring breakers, but here as faint as the humming of a swarm of bees. With a little geographical training the physiographical history of the island is easily read. Not so plain is its story for the biologist. He faces a number of difficult problems, and like difficulties confront the zoölogist. The fauna, at first, does not seem to be very rich. There are no indigenous mammals, and, save for sea birds, winged life is poor in species. The most remarkable bird is a humming-bird (*Eustephanus fernandensis*), famous among ornithologists on account of the sexual difference. However, of lower animals a great many are found, such as land molluscs, insects, and spiders, and many of them are endemic.

The barren western parts of Mas-a-tierra are of less interest. Weeds, from Chile or Europe, are very abundant, quite obscuring the original vegetation, of which but small areas like that in Figure 10 remain. On Santa Clara fresh water is altogether wanting. In crevices of the high coast cliffs some good specimens of *Dendroseris,* of two species, do fairly well. A rock close to Santa Clara, separated from it only at high tide, offers a most striking picture with the numerous *Dendroseris* trees, *D. macrophylla* prevailing (Fig. 11).

The Island of Mas-afuera

The island of Mas-afuera, mentioned in the opening paragraph, is distinctly inaccessible. In 1909 the Chilean Government established a penal settlement here, and more or less ruinous buildings may be seen in many places. Expensive landing arrangements were made, but since the place was abandoned, in 1913, they have become completely destroyed. There is no harbor and no safe anchorage anywhere. The surf often makes landing impossible; it is always more or less precarious, so that the assistance of skilled hands is necessary. We had chartered a schooner to take us there, but our first attempt was fruitless and we lost a week. The second, however, was successful, and we landed our impedimenta without damage. The settlement was situated at the mouth of the Quebrada de las Casas. We made ourselves as comfortable as possible in the best house of the now uninhabited island.

Difficulties of Access

Mas-afuera has a rather striking appearance. It is a solid rectangular block of sheeted lava, on all sides terminating in perpendicular cliffs. For the most part a narrow strip of boulders along the beach permits a passage round and makes it possible to enter all the valleys which reach the sea. The west side is much higher than the east, and all along that side there is a

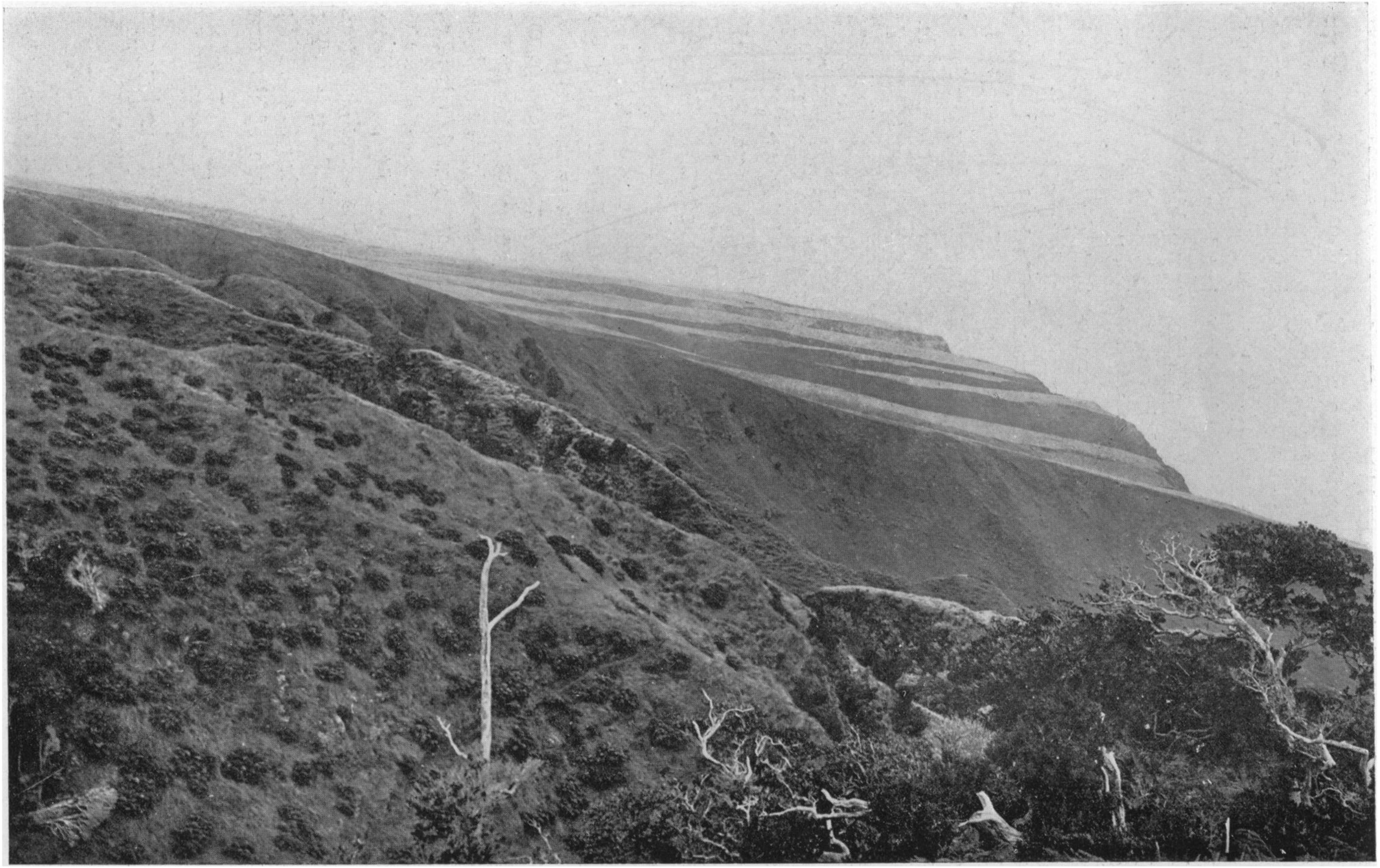

FIG. 12—The upland surface of Mas-a-tierra, its eastern border dissected into numerous rectilinear canyons (see map, Fig. 1).

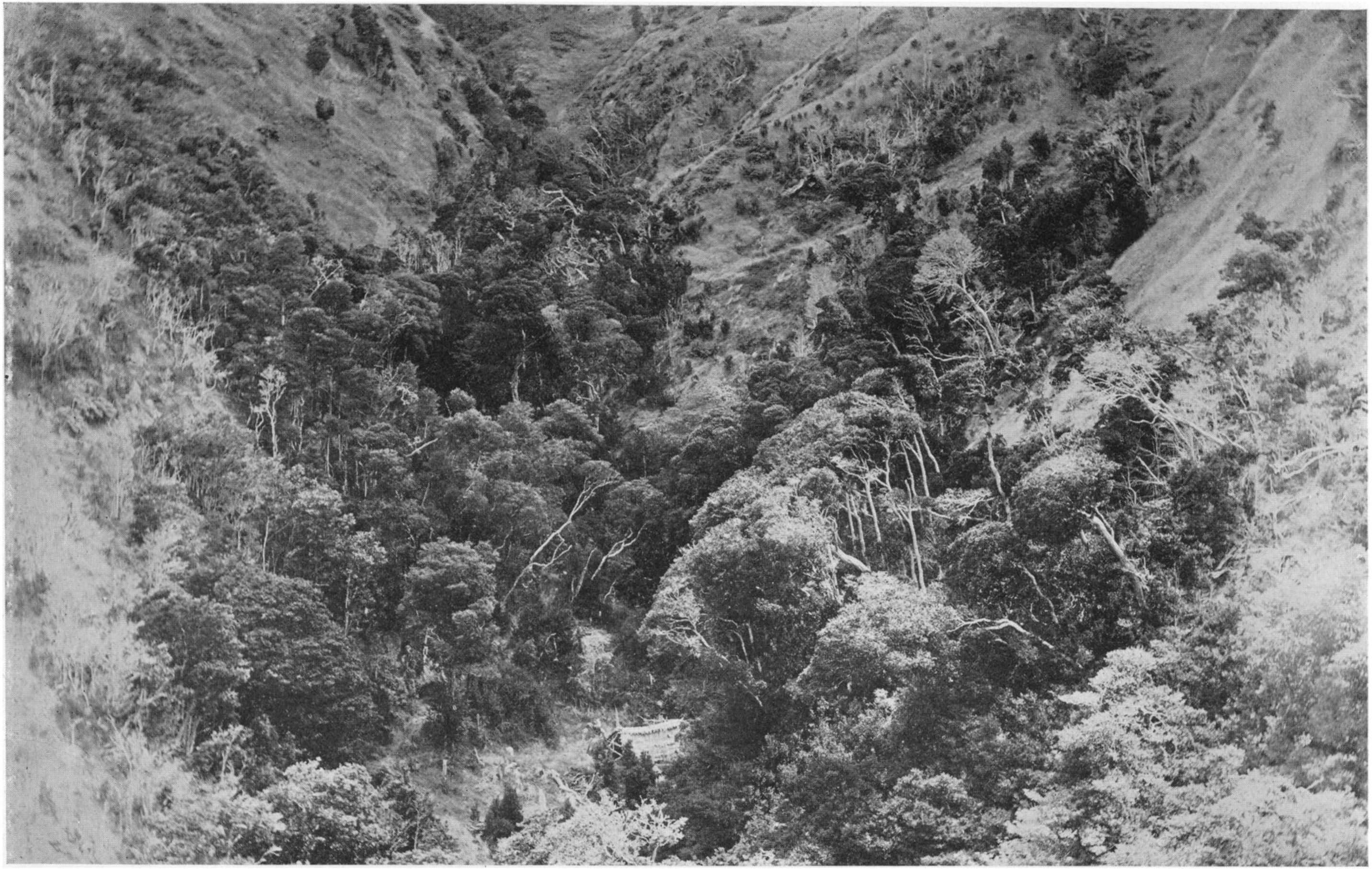

FIG. 13—Forest patch in a Mas-afueran valley. The forest on this island is confined to the middle levels of the valleys (1,000-2,200 feet), the limits, in contrast with Mas-a-tierra, being climatic. Above is a meadow and alpine zone; below a luxuriant fern vegetation flourishes.

sheer drop of four to five thousand feet. From the longitudinal ridge a great number of canyons radiate to the northeast and southeast (Fig. 12). Their heads are usually occupied by high waterfalls, often nearly dry in summer (Fig. 14). Some of these canyons, in the relative dimensions of depth and width of bottom, hardly have their equals anywhere. A good example is shown in Figure 17. There is practically no margin between the stream and the perpendicular wall. Small waterfalls and heaps of huge boulders must be passed in order to enter; it may even be impossible to enter at all. Fresh pieces of rock, fallen down from the height of some two or three thousand feet, show that the place is not absolutely safe. The two central valleys, which drain the highest and rainiest part, have cut back into the island so far and so deep as nearly to divide it in two. These two valleys, Casas and Vacas, are separated by a high and narrow ridge, so steep that its sides cannot be climbed. But near the sea a trail, cut by the convicts, leads up on the ridge, and from there a goats' track leads all round the end of the Casas valley to the northern half of the highland, where two summits reach 4,700 feet. This promenade is one to be recommended. It is a little tiresome and, of course, should not be tried by anybody likely to get dizzy, for in several places there is just sufficient space for your feet, if they be not too large, and on both sides you look down into a canyon with a winding silver streak glittering below you—there is a chance for a clean fall of two or three thousand feet on either side. The southern portion of the upland cannot be reached in the same convenient manner, for it is impossible to climb along the head wall of the Vacas canyon, even for the goats I believe. Just beyond is the highest summit, most inappropriately called Los Inocentes. It can only be reached from two places near the sea; the easiest is the south wall of the Vacas canyon (Fig. 15). The ascent is not without danger, for the slope is covered with very slippery grass and loose stones. Shoes should not be used, and the nearly lost faculty of grasping with the toes should be exercised if possible. Our first attempt, made from the southeast corner of the island, a very dangerous place, was frustrated after we had got over the worst part, for we met a mile-wide and impenetrable forest of fern trees and came into a thick fog. Later we started from a point just south of the Vacas valley and had complete success. We found the top to be 5,300 feet high, a considerable figure in comparison with the small size of the island.

Its Vegetation

We have no exact knowledge of the climate. It is not greatly different from that in Mas-a-tierra, for many vegetable products are the same. But, of course, there is nothing in Mas-a-tierra to match the high upland of Mas-afuera. Residents in the penal colony have reported that it not seldom appears white with frost in winter. The coast cliffs and lower slopes are dry and warm and have a steppe vegetation.

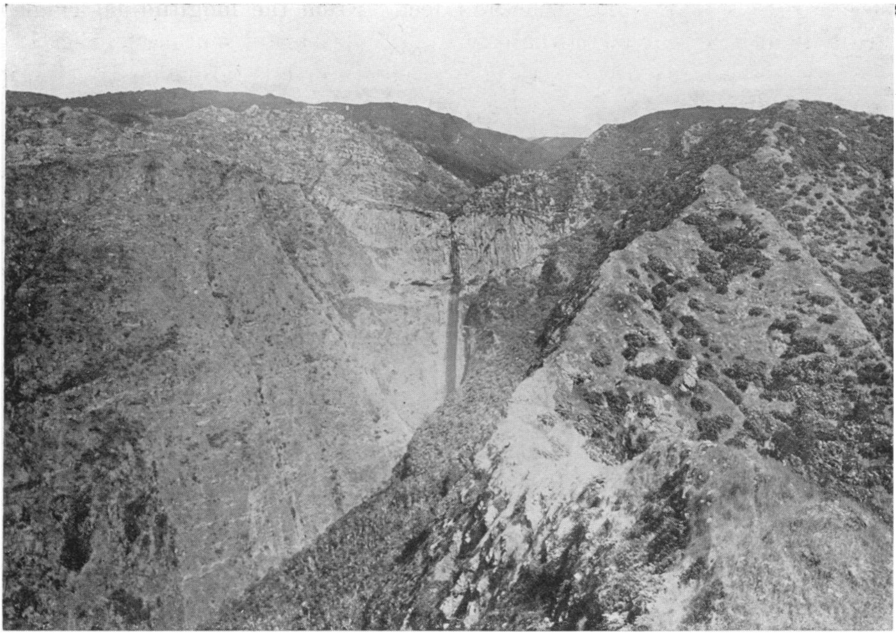

Fig. 14.

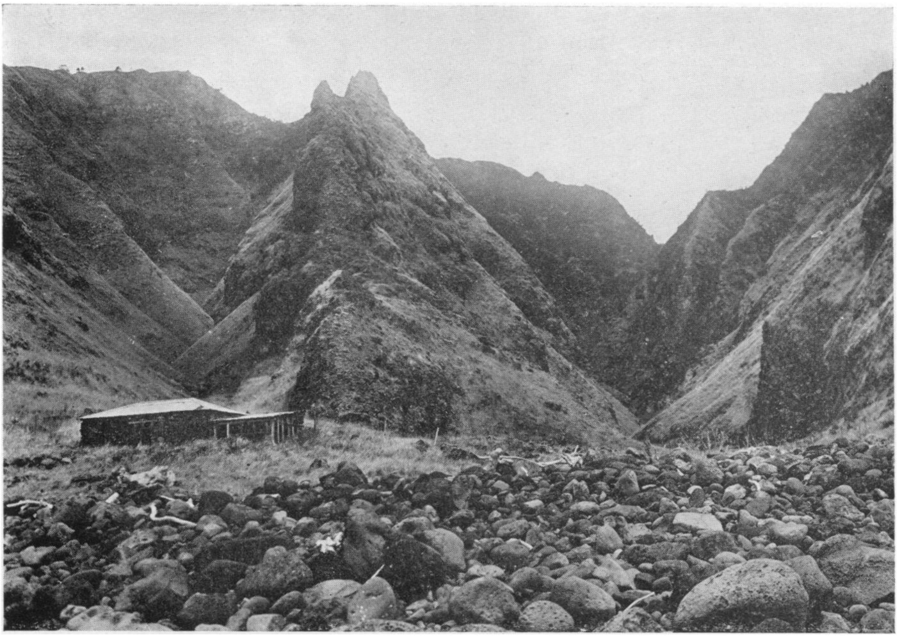

Fig. 15.

Fig. 14—Head wall of a deep canyon on the eastern side of Mas-afuera.

Fig. 15—The entrance of the Quebrada de las Vacas, Mas-afuera. Boulder beach in the foreground. The ascent is made up the gully on the left and then along the south (left) wall of the canyon.

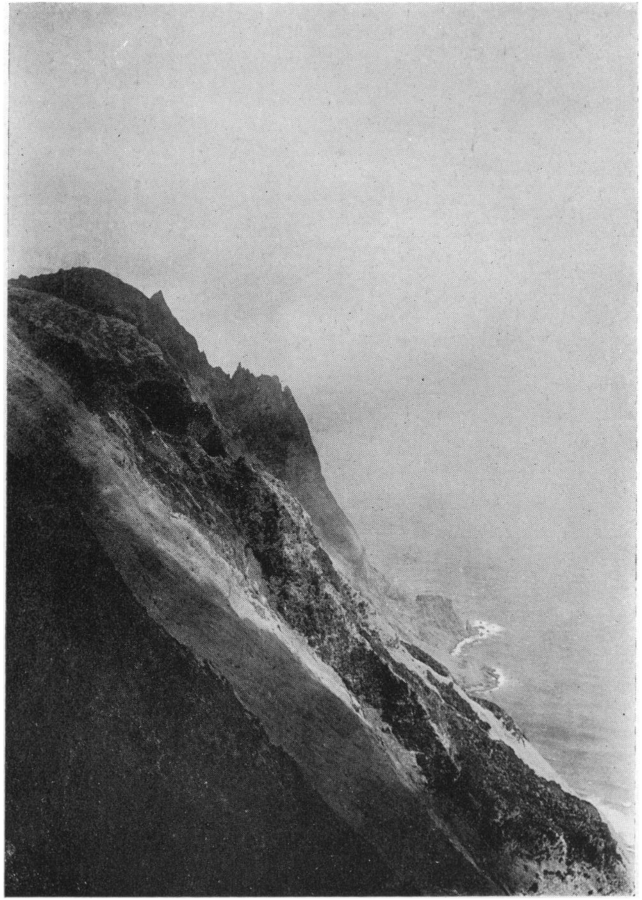

Fig. 16—The steep western side of Mas-afuera, falling away 4,000 or 5,000 feet to the sea.

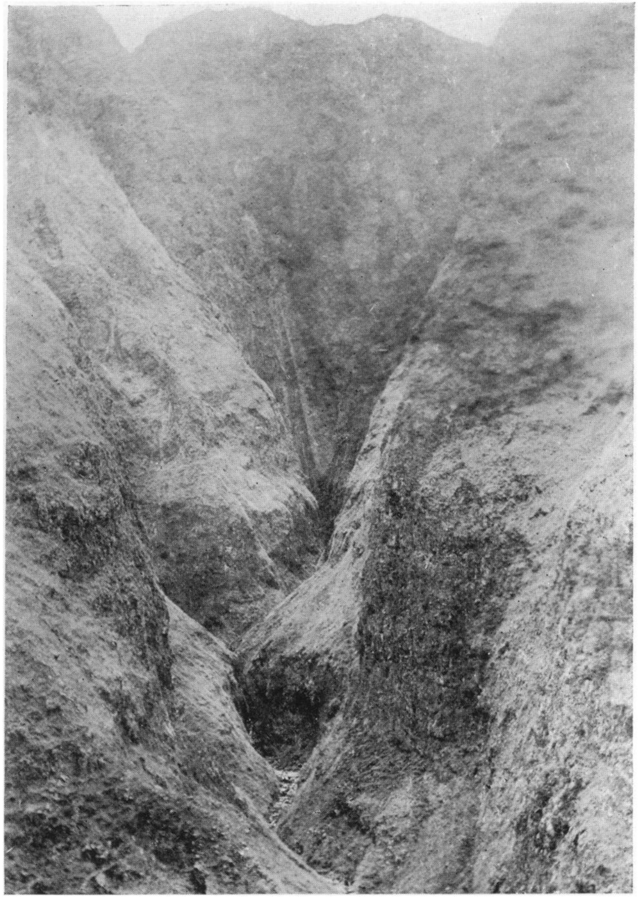

Fig. 17—Typical canyon in Mas-afuera. Some of these canyons hardly have their equals in steepness anywhere.

The forest is confined to the middle part of the valley systems, forming an interrupted belt between 1,000 and 2,200 feet above sea level. Figure 13 gives a good idea of this forest. It is largely composed of an endemic myrtle tree (*Myrceugenia Schultzei*). Beautiful groves of *Dicksonia* fill the damp corners. Along the upper parts of the forest and ranging up into the next region are a number of miniature trees of the *Robinsonia* type, some only found on this island and now made known for the first time. The forest limit here is a climatic one, probably a matter of summer temperature. Above this line we enter the foggy region, covered by extensive meadows and vast beds of ferns. To this region belongs the marvelous pure *Dicksonia* forest around Los Inocentes. The meadows must have been quite different before the arrival of man, for they are invariably formed in the main of two European plants.

Its Wild Scenery

Above 3,500 feet the scenery grows more and more alpine in character. Mas-afuera has a really alpine region, notable for its Magellanic flora. It is not a question of the miraculous arrival of some stray species from the far south: it is a whole flora, forming natural associations, with mosses, lichens, ferns, and flowering plants. The nature of the locality is shown in Figure 19.

There is a first-rate surprise in store for the traveler when he reaches the upland and strolls across toward its western border. There he suddenly stops—and he is wise in doing so, for at his feet opens an abyss (Fig. 16). Four or five thousand feet below him the breakers come rolling in; cliffs are cut and torn to the most incredible shapes; there are perfect combs, overhanging shelves, oblique needles, ready to fall. It is wild scenery indeed and may fairly be compared to the hell of Dante as pictured by Doré.

Let us hasten down into one of the canyons, where there is rest and peace. It is nature's own greenhouse. What a variety of beautiful ferns! What life on every ledge, in every corner where soil is to be found. Along the stream are imposing groups of a fine *Gunnera,* discovered by me in 1908, and endemic in this island. Its leaves measure as much as 10 feet across (Fig. 20). The stalks are edible and refreshing, with a slightly acid taste.

Floral Elements Needing Explanation

Such are the Juan Fernandez Islands. As soon as our collections have been studied full account of our results will be given. I shall try to explain the origins of this quaint life. There is one decidedly Chilean element, related to the flora of Valdivia, but the occurrence of Chilean types is not surprising. Then there is the Magellanic, or subantarctic, element, not represented in Mas-a-tierra. It may have immigrated at a time when it had a wider range on the continent, as was the case during the Glacial Epoch. There is, further, a small tropical element without relations to the

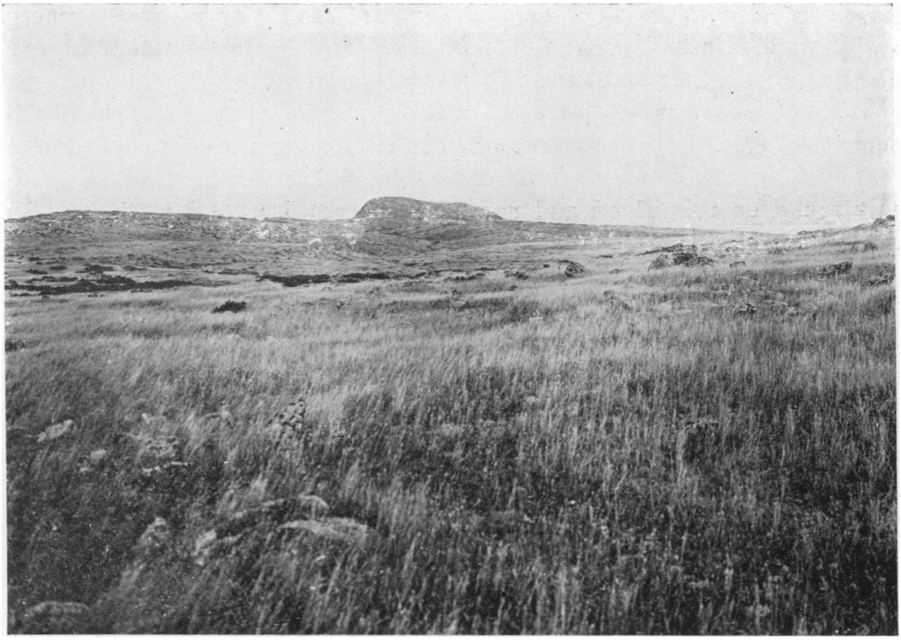

Fig. 18.

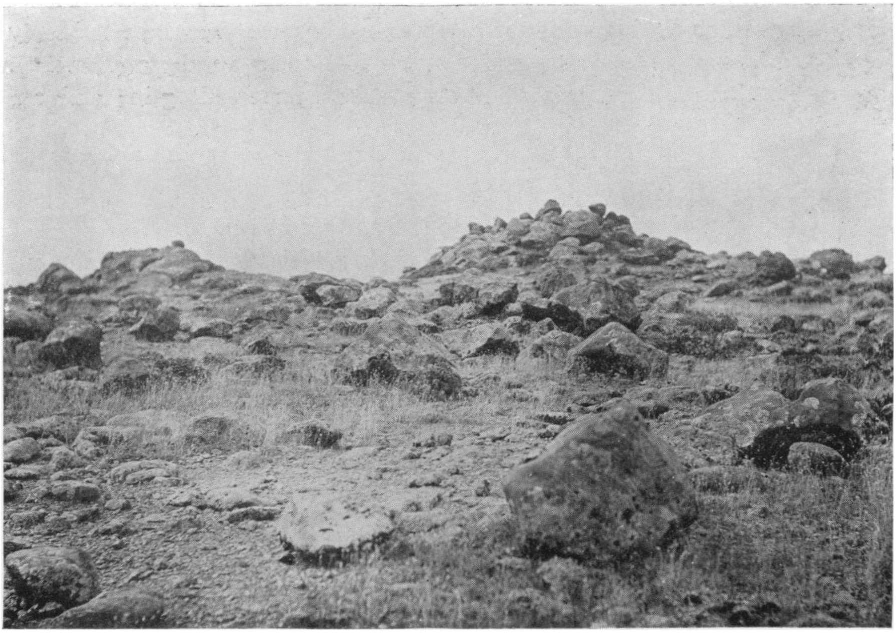

Fig. 19.

Fig. 18—The upland on Mas-afuera where the first Magellanic plants were discovered in 1908.
Fig. 19—Alpine scenery on the upland of Mas-afuera.

present flora of Chile. But this country once had a tropical flora. There was no high cordillera separating it from the rest of the continent at that time. Unfortunately, our knowledge of this flora is very small.

Finally, there is the very special element, the strange-looking endemic plants which either have no relations at all or give doubtful hints towards distant parts of the immense Pacific Ocean. Did they come across the vast waters from many lands and become transformed into new species and genera, while their ancestors disappeared altogether? The very slow rate of evolution negatives this theory. Possibly they, together with others in other islands, form the scattered remains of an ancient Pacific flora, of which the bulk has perished. But where did they come from? Was there a continent, a group of larger islands? Was Juan Fernandez once a part of something, of some mysterious land? I shall only point to one fact. Our islands are situated on a deep submarine ridge, which can be followed north to San Felix and San Ambrosio. These latter islands have a very different climate, but they have, nevertheless, some ancient endemic plants. Unfortunately, it was not possible for us to visit this place, as no transportation facilities could be obtained from the Chilean government.

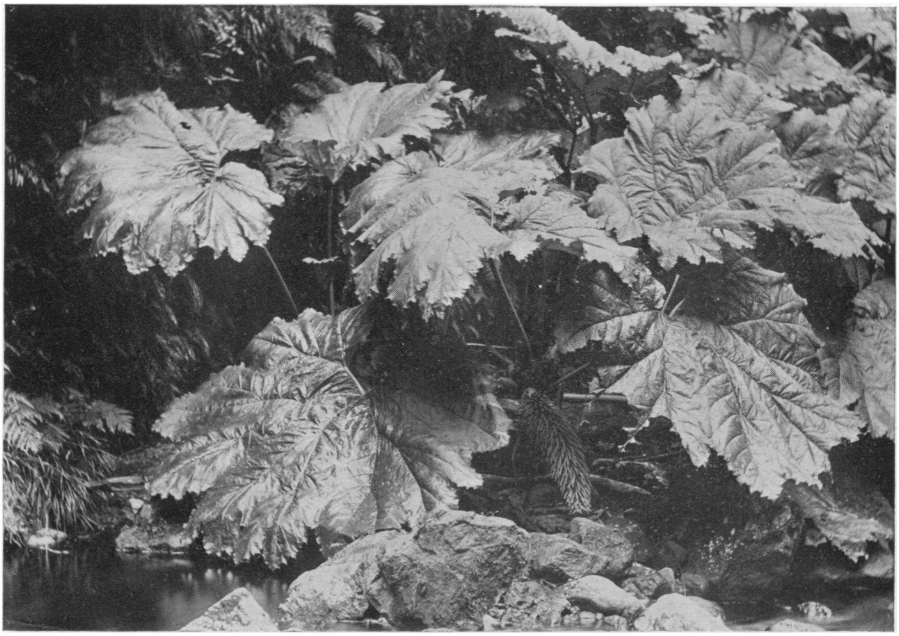

Fig. 20—*Gunnera Mas-afuerae* **in the Quebrada de la Casas, Mas-afuera. The leaves sometimes measure as much as 10 feet across. See also Fig. 5.**